

Carotid Endarterectomy at Punjab Institute of Cardiology, Lahore: Mid Term Postoperative Results

A WAHEED A SHAHBAZ A GHAFAR A R ABID NAHMED J S KHAN.

Department of cardiac surgery, Punjab Institute of Cardiology, Lahore
Correspondence to Dr Abdul Waheed

Objective. This study was designed to review postoperative results of the carotid endarterectomy (CABG/CEA) performed at the Punjab Institute of Cardiology, Lahore. **Material and methods.** Consecutive 10 patients with coexisting severe ischemic cardiac and carotid artery disease were operated on during 1-year period ending December 2003 at Punjab Institute of Cardiology, Lahore. **Results:** The mean age of the study population was 60.20 ± 7.56 years, among these 9 were male and 1 female patient. Four (40%) patients with carotid artery stenosis were asymptomatic. Previous stroke occurred in 2 (20%) patients: two (20%) patients presented with a history of blackouts and two (20%) with a transient ischemic attack. The mid term results with regard to 30-day postoperative mortality, stroke and major postoperative complications were significantly low in terms of post operative infection as only one (10%) patient had chest infection and there was no in-hospital mortality. **Conclusions.** Combined interventions of CE and CABG can be performed with an acceptable morbidity and mortality when severe carotid stenosis is associated with advanced, symptomatic ischemic heart disease. The introduction of routine preoperative carotid duplex scanning resulted in higher diagnostic rate for asymptomatic carotid artery disease among the patients scheduled for combined CABG/CE procedure.

Key Words. CABG, Carotid Endarterectomy,

Atherosclerotic disease is diffuse in nature the coexistence of carotid artery and coronary artery disease is to be expected in some patients. The reported incidence of significant carotid stenosis (>70% diameter narrowing) in patients undergoing coronary artery surgery was between 2 to 22%^{1,2}. After introduction of the routine preoperative screening carotid doppler ultra-sonography, the rate of asymptomatic carotid artery stenosis among all diagnosed hemodynamically significant carotid stenoses has raised up to 43.8%³.

Recent reviews revealed that the risk of stroke after coronary artery bypass grafting (CABG) was <2% in patients with no significant carotid disease (bilateral 0-49% stenoses), 3% in predominantly asymptomatic patients with unilateral 50-99% stenosis, increasing to 5% in those with bilateral 50-99% stenosis and 7-11% in patients with carotid occlusion^{4,5}.

The benefit of CEA in both significant asymptomatic and symptomatic carotid disease has been clearly demonstrated, surgical intervention to the coexisting carotid artery disease in coronary bypass patients is strongly advisable⁶.

Treatment options for the management of patients with concomitant disease include combined CEA and coronary artery bypass grafting (CABG), CEA followed by CABG (staged), and CABG followed by CEA (reversed staged)⁷.

We report the midterm results from our experience with combined operative treatment of concomitant coronary and carotid artery occlusive disease.

Material and methods:

Out of 1452 consecutive patients undergoing CABG at our institution between January 2003 and December 2003, 10

patients (1.45%) with coronary artery disease and carotid artery disease underwent combined CABG and CEA.

Indications of Carotid Endarterectomy

- Unilateral Carotid Endarterectomy with CABG if stenotic lesion $\geq 60\%$ in symptomatic patients.
- CABG required with bilateral asymptomatic stenosis >70%.

At our unit noninvasive carotid artery examination (Doppler ultrasonography) was performed in all CABG patients with a history of transient ischemic attack, amaurosis fugax, reversible ischemic neurologic deficit, stroke, or other central nervous system complaints suggestive of extracranial cerebrovascular disease, 50% or greater left main coronary disease, presence of audible carotid bruits, evidence of other extensive vascular disease, and patients aged 60 years or older. All patients were identified as having no significant stenosis (<50%), moderate (50% to 70%) to severe (70% to 99%) stenosis or a 100% occlusion of either or both carotid arteries by noninvasive carotid examination.

Patients with a 70% or greater stenosis, selective carotid arteriography was performed. In 8 patients a diameter reduction of more than 70% of the internal carotid artery relative to the normal distal internal carotid artery shown by angiography was demonstrated and a combined carotid and cardiac operation was performed.

Data was collected for every patient that included demographic profiles (age, gender, diabetes mellitus, hypertension, hyperlipidemia, prior myocardial infarction, peripheral vascular disease, prior cerebrovascular event (stroke, transient ischemic attack, amaurosis fugax), active smoking, congestive heart failure, left ventricular dysfunction, left main coronary artery disease, triple vessel disease, presence of unstable angina pectoris), operative variables (cardiopulmonary bypass (CPB) time, cross

clamp time, perioperative myocardial infarction, perioperative excessive hemorrhage) and postoperative data (need for inotropics, intraaortic balloon pump, rhythm disturbances, stroke, transient neurologic deficit, pulmonary insufficiency, serious infection).

Patients with carotid artery occlusive disease were classified by status as symptomatic or asymptomatic. Symptomatic patients included those who had focal, transient neurologic symptoms, amaurosis fugax, or a completed stroke. Asymptomatic patients had no evidence of neurologic findings. Perioperative myocardial infarction was defined as either new Q waves or the elevation of the creatine kinase levels in association with persistent ST segment changes or a new left bundle-branch block. Neurologic complications were divided into two groups; stroke and temporary neurologic dysfunction. Postoperative stroke was defined as any clinically evident focal or general neurologic deficit that was not present before operation but was identified after operation and new lesions diagnosed by computed tomography. Deficit was reported as occurring ipsilateral or contralateral to the CEA. Carotid stroke was defined as a uni-hemispheric stroke ipsilateral to the carotid endarterectomy.

Any patients, who had not recovered neurologically from the operation within 48 hours; who were comatose or semi comatose were included in the definition of stroke. Temporary neurologic dysfunction was defined as a transient disorientation, agitation, delirium and character changes with no neurologic sequelae.

Operative mortality was defined as any death that occurred during the hospitalization. Any deaths which occurred after discharge from the hospital but within 30 days of the procedure were included in the term of operative mortality unless the cause was clearly unrelated to the operation.

Procedures:

Coronary Artery Bypass Grafting and Carotid Endarterectomy procedures were done in all patients in simultaneous fashion under general anesthesia. The same surgeons and operative team performed all procedures. In all patients CEAs were performed prior to sternotomy. In case of bilateral internal carotid artery lesions we performed CEA on the side with the higher degree lesion, the side related to neurological symptoms, or the dominant hemisphere. CEA of completely occluded vessels was not performed. During CEA, saphenous veins were prepared. A standard oblique cervical incision was made. After isolation of the common, internal, and external carotid arteries, 2 ml of heparin was administered. Vessels were clamped and an arteriotomy was created in the common carotid artery and extended into the internal carotid artery.

An intraluminal carotid shunt was not needed in any patient. The artery was opened distally beyond the distal extent of the plaque. The plaque was removed in the standard fashion. If the artery was thought to be small, the

arteriotomy was closed with a saphenous vein patch. Heparin was not reversed. After completion of the CEA, the neck incision was left open until heparin reversal after Cardiopulmonary Bypass. After CEA, CPB was instituted with standard techniques.

Distal anastomoses were performed with a single aortic cross clamp and proximal anastomoses generally performed with a partial occluding clamp unless there appeared to be severe atherosclerosis of the ascending aorta.

Statistical analysis

Statistical analysis was performed using the SPSS (release 10.0; SPSS, Inc; Chicago, IL) system for Windows. Categorical variables were analyzed using the χ^2 or Fisher's exact test and continuous data were analyzed using Student's *t* test. Associations with outcomes were considered statistically significant when *p* values were less than 0.05. All tests applied were two tailed.

Results:

Out of 1452 patients undergoing for CABG only 10(1.452%) patients were studied after fulfilling the inclusion criteria. Among the study patients 9(90%) patients were males and 1(10%) were females. The mean age was 60.20 ± 7.58 years.

A history of hypertension was present in 6(60%) patients and hyperlipidemia was present in 4(40%) patients. Two (20%) patients were smokers.(Table 1)

Majority of study population 6(60%) patients presented with acute coronary syndromes i.e. Unstable Angina was present in 5(50 %) patients, prior myocardial infarction in 1(10%) patients, and 4 (40%) patients had a history of stable angina (Table 2). Triple vessel coronary artery disease was present in 6 (60%) patients. Left main coronary artery disease with multivessel disease was present in 3 (30%) patients (Table 3). However, each of these patients had at least 70% stenosis at the carotid bifurcation and only 6(60%) patients were symptomatic with symptoms of TIAS, Blackouts and previous history of stroke in 2(20%) patients in each category respectively. Four (40%) patients had no neurological symptom and were admitted to the hospital because they had symptoms of cardiac disease. Their carotid artery disease was diagnosed during preoperative evaluation.

Carotid Angiography was done (Figure 1), carotid angiographic findings were as follows: Bilateral carotid artery disease 7(70%), Left common carotid artery disease 1(10%), Left Internal carotid artery disease 1(10%) and Right Internal carotid artery disease 1(10%) (Table 3).

Left Carotid Endarterectomy was done in 6(60%) patients with the distribution shown in table 4. While right carotid endarterectomy was done in 4(40%) patients. LIMA was grafted to LAD in 9(90%) patients and Coronary endarterectomy was performed in one(10%) patient.

Mean cardiopulmonary bypass time was 3.08 ± 1.34 hours. None of the patients had perioperative myocardial infarction or perioperative excessive hemorrhage. Mean ICU stay time was 2.1 ± 1.3 days. One patient needed Intra aortic balloon pump because of moderate left ventricular dysfunction. None of the patients expired during the hospital stay.

Table 1. Epidemiological characteristics (n=10)

Age	60.20±7.58	
Male	9(90%)	
Female	1(10%)	
Hypertension	6(60%)	
Diabetes mellitus	4(40%)	
Hyperlipidemia	4(40%)	
Smoking	2(20%)	
Family histoy	4(40%)	
Ejection fraction	56.90±10.09	

Table 2. Presenting characteristic (n=10)

Presenting characteristic	n=	%age
Acute coronary syndromes	06	60
Acute myocardial infarction	01	10
Unstable angina	05	50
Neurological symptoms		
None	04	40
H/O TIAS	02	20
H/O stroke	02	20
Blackouts	02	20

Table 3. ANGIOGRAPHIC FINDINGS

Vessels	n=	%age
Coronary artery disease		
Single vessel disease	01	10
Tripple vessel disease	06	60
LMS with multi vessel disease	03	30
Carotid angiographic findings		
Bilateral carotid artery disease	07	70
Left common carotid artery disease	01	10
Left interior carotid artery disease	01	10
Right interior carotid artery disease	01	10

Table 4. Operative date (n=10)

	n=	%age
Lt Carotid Endarterectomy+CABG x 1V+Lima-LAD	01	10
Lt Carotid Endarterectomy+CABG x 2V+Lima-LAD	02	20
Lt Carotid Endarterectomy+CABG x 2V+Lima-LAD+CORONARY Endarterectomy	01	10
Lt Carotid Endarterectomy+CABG x 3V + Lima-LAD	02	20
Rt carotid Endarterectomy+CABG x 2V +Lima-LAD	02	20
Rt carotid Endarterectomy+CABG x 4V	01	10
Rt carotid Endarterectomy+CABG x 1 , Lima-LAD	01	10

Table 5. In hospital course

Variable	n=	%age
ICU stay time mean days	2.1±1.3	
IABP insertion	01	10
Chest infection + tracheostomy	01	10
In hospital mortality	0	0

Discussion:

Patients with cerebrovascular and coronary artery disease represent a subset of high-risk patients with advanced arteriosclerosis. When surgical treatment of concurrent carotid and coronary artery disease can be done in either a combined or staged fashion. The optimal management of these patients is controversial. The superiority of one approach has not been established by prospective trial and remains controversial.

Some investigators have reported satisfactory results for combined carotid and coronary surgery⁸. However, others using a staged CEA and CABG have obtained equivalent or superior results.⁹ We initially preferred a staged procedure in a few patients but as we have gained more experience we tend to perform both procedures during the same operation.

Although perioperative stroke remains a rare event, it is the most catastrophic complication of cardiac surgery, and leads to excessive morbidity, mortality, and increased health care costs¹⁰. Potential causes of these perioperative neurologic deficits are multifactorial and include cerebral hypoperfusion, embolization of atheromatous material from an atherosclerotic aorta, thromboembolism from the left ventricle or the left atrium, air embolism, embolization of microaggregates of blood elements formed during CPB, intracranial hemorrhage and the presence of extracranial carotid artery disease^{11,12}.

In our study significant number of patients had triple-vessel coronary artery disease (6 patients, 60%), 3(30%) had left main disease and 1(10%) had depressed left ventricular function (EF<30%). In addition; the risk factors for atherosclerotic disease included an age exceeding 60 years (43.2%), hypertension (60%), hyperlipidemia (40%) and Diabetes Mellitus in 4(40%) patients.

The prevalence of significant carotid disease in the cardiac surgical population reflects the systemic nature of the atherosclerotic process. Carotid artery stenosis greater than 50%, redo surgery, peripheral vascular disease, longer pump time, and hypercholesterolemia were found to be independently associated with an increased risk of stroke and mortality¹³. D'Agostino, *et al* assessed the incidence and risk factors for stroke in 1835 patients undergoing CABG and found that carotid stenosis >50% was a risk factor in this population¹⁴. Salasidis, *et al* found that the incidence of postoperative neurologic events in patients with severe carotid disease (>80% stenosis) was 18.2% and 1.7% in patients without severe carotid disease¹⁵.

The efficacy of carotid endarterectomy for patients with either symptomatic or asymptomatic carotid stenosis is another issue. The North American Symptomatic Carotid Endarterectomy Trial (NASCET) and European Carotid Surgery Trial (ECST) both showed that carotid endarterectomy had a beneficial effect in symptomatic patients with 70%-99% carotid stenosis¹⁵. The Asymptomatic Carotid Atherosclerosis Study (ACAS) has demonstrated that surgery is beneficial for the reduction of total ipsilateral neurologic events in patients with 60% carotid stenosis from 18% to 7% over 5 years¹⁶.

The benefit of CEA in both symptomatic and asymptomatic patients has been well defined, and severe carotid artery stenosis will be encountered in an important number of coronary artery patients, carotid artery surgery cannot be ignored in these patients. Central nervous system risk is significantly increased when the reverse staged procedure is used, wherein the coronary artery bypass precedes the CEA. Hertzler, *et al* found a much higher risk of stroke when CEA followed rather than preceded coronary artery bypass; however, the mortality rates were similar¹⁷. Cerebral revascularization should precede coronary revascularization. CABG may be performed prior to CEA in truly emergent, unstable coronary artery bypass patients with critical coronary disease and elective carotid disease. If the combined procedure does indeed result in a higher risk of stroke or death, there are several possible reasons. One reason may be that the combined procedures are more technically difficult, from both a surgical and an anesthetic point of view, resulting in more perioperative complications. Another reason may be that combined operations result in excessive stress on the cardiovascular and cerebrovascular systems, resulting in large fluctuations in patient hemodynamics during relatively long operative procedures.

On the other hand the presence of severe disease in one arterial system poses an important threat to the patient with combined diseases if an operation addresses only the disease in the other system. Also, Hertzler and Arison have documented that the greatest long-term risk to all carotid patients is the risk of myocardial infarction, the principal cause of death in this population¹⁸. Angiographically normal coronary anatomy was detected in only 9% of patients undergoing carotid endarterectomy, whereas 26% were found to have severe coronary artery disease¹⁹. Coronary artery disease, an extremely common coexistent disease process, poses important short-term and long-term risks to patients with carotid artery stenosis.

Stroke is an important complication of coronary artery bypass grafting and the incidence is rising. Reed, *et al* found that the presence of carotid bruits increased the risk of stroke 3.9 fold after coronary artery bypass grafting²⁰.

Brenner, *et al* examined the issue of combined and staged CABG / CEA. They demonstrated that staged procedures may result in a higher risk of myocardial

infarction, particularly in the perioperative period of the carotid operation, with no difference in stroke rates. Indeed they found a very high incidence of stroke in patients undergoing such "reverse-staged" procedures²⁰.

The combined stroke and mortality rate was about 0 in our patients selected for combined CEA and CABG on the basis of our criteria. Our in-hospital results with concomitant carotid and coronary operations are comparable to those of other results published during the last ten years

Prospective randomized trials need to determine which groups of patients with carotid artery stenosis less than 70% will benefit from combined procedures.

In conclusion, carotid endarterectomy and coronary artery bypass grafting are each appropriate treatments for carotid and coronary disease. Important concurrent carotid artery disease should be suspected in cardiac surgical patients, especially the aged. An aggressive system of screening should be undertaken. Both diseases pose an important adverse risk during operations that address only one of the lesions. Previously published reports and our study show that combined CABG and carotid endarterectomy are performed in higher-risk populations.

Concomitant carotid Endarterectomy and coronary artery bypass grafting is the preferred approach in high-risk population with severe coexistent disease.

References:

1. Faggioli GL, Curl R, Ricotta JJ. The role of carotid screening before coronary artery bypass. *J Vasc Surg* 1990;12: 724-31.
2. Lazar HL, Menzoian JO. Coronary artery bypass grafting in patients with cerebrovascular disease. *Ann Thorac Surg* 1998; 66: 968-74.
3. Benetis R, Girdauskas E, Kinduris S, Ereminiene E. Combined coronary artery bypass grafting and carotid Endarterectomy: early postoperative results and perspectives. *MEDICINA* 2003;39(4):397-398.
4. Naylor AR, Cuffe RL, Rothwell PM, Bell PRF. A Systematic Review of Outcomes Following staged and synchronous Carotid Endarterectomy and Coronary Artery Bypass. *Eur J Vasc Endovasc Surg* 2003;25:380-89.
5. Naylor AR, Mehta Z, Rothwell PM, Bell PRF. Carotid artery disease and stroke during coronary artery bypass: A critical review of the literature. *Eur J Vasc Endovasc Surg* 2002;23:283-94.
6. North American Symptomatic Carotid Endarterectomy Trial Collaborators. Beneficial effect of carotid Endarterectomy in symptomatic patients with high-grade carotid stenosis. *N Engl J Med* 1991; 325: 445-53.
7. Naylor AR, Mehta Z, Rothwell PM, Bell PRF. Carotid artery disease and stroke during coronary artery bypass: A critical review of the literature. *Eur J Vasc Endovasc Surg* 2002;23:283-94.
8. Rizzo RJ, Whittemore AD, Couper GS, *et al*. Combined carotid and coronary revascularization: the preferred approach to the severe vasculopath. *Ann Thorac Surg* 1992; 54: 1099-109.

9. Jones EL, Craver JM, Michalik RA, *et al.* Combined carotid and coronary operations: when are they necessary? *J Thorac Cardiovasc Surg* 1984; 87: 7-16.
10. Tuman KJ, McCarthy RJ, Najafi H, Ivanovich AD. Differential effects of advanced age on neurologic and cardiac risks of coronary bypass. *J Thorac Cardiovasc Surg* 1992; 104: 1510-7.
11. Schwartz LB, Bridgman AH, Kieffer RW. Asymptomatic carotid artery stenosis and stroke in patients undergoing cardiopulmonary bypass. *J Vasc Surg* 1995; 21: 146-53.
12. Mehigan JT, Buch WS, Pipkin RD, Fogarty TJ. A planned approach to coexistent cerebrovascular disease in coronary artery bypass candidates. *Arch Surg* 1977; 112: 1403-8.
13. Ricotta JJ, Faggioli GL, Castilone A, Hassett JM. Risk factors for stroke after cardiac surgery: Buffalo Cardiac-Cerebral Study Group. *J Vasc Surg* 1995; 21: 359-63.
14. D'Agostino RS, Svensson LG, Neumann DJ, Balkhy HH, Williamson WA, Shahian DM. Screening carotid ultrasonography and risk factors for stroke in coronary artery surgery patients. *Ann Thorac Surg* 1996; 62:1714-23.
15. European Carotid Surgery Trialists' Collaborative Group. MRC European Carotid Surgery Trial: interim results for symptomatic patients with severe (70-99%) or with mild (0-29%) carotid stenosis. *Lancet* 1991;337: 1235-43.
16. Naylor AR, Cuffe RL, Rothwell PM, Bell PRF. A Systematic Review of Outcomes Following staged and synchronous Carotid Endarterectomy and Coronary Artery Bypass. *Eur J Vasc Endovasc Surg* 2003;25:380-89.
17. Hertzner NR, Loop FD, Beven BG. Surgical staging for simultaneous coronary and carotid disease: a study including prospective randomization. *J Vasc Surg* 1989; 9: 455-63.
18. Hertzner NR, Arison R. Cumulative stroke and survival ten years after carotid endarterectomy. *J Vasc Surg* 1985; 2: 661-8.
19. Hertzner NR, Beven EG, Young JR. Coronary artery disease in peripheral vascular patients. A classification of 1000 coronary angiograms and results of surgical management. *Ann Surg* 1984; 199: 223-33.
20. Brenner BJ, Hermans H, Eisenbud D. The management of patients requiring coronary bypass and carotid endarterectomy. *Surgery for cerebrovascular disease*. WB Saunders, Philadelphia, 1996, 280-7